

This is an interesting and informative book, written for high-school students but with plenty of stories of interest to other general readers and to professional astronomers. There are a few infelicities in the (American) English, but I only found three typos: on p. 52, four lines from the foot, Royal Society should be Royal Astronomical Society (the famous Chandrasekhar–Eddington disagreement occurred at a meeting of the RAS), on p. 101, line 2, ‘Causal’ should be ‘Casual’, and on p. 103, section 6.31 line 1, Martin should be Maarten. A Glossary will help the general reader and there is a useful index (although it doesn’t include people’s names). There are no references to any of the original work. — ROBERT CONNON SMITH.

**Introduction to General Relativity and Cosmology**, by Ian R. Kenyon (IoP Publishing), 2023. Pp. 307, 26 × 18.5 cm. Price £75/\$120 (hardbound; ISBN 978 0 7503 3761 8).

General Relativity is more than 100 years old, and the number of GR textbooks about it probably exceeds 100, beginning with Einstein himself (1920, *Relativity, the Special and General Theory*, translated by Robert W. Lawson from *Über die spezielle und die allgemeine Relativitätstheorie*) and Arthur S. Eddington (1920, *Space, Time, Gravitation*). The midpoint from then to now is marked by the massive *Gravitation* by Charles W. Misner, Kip S. Thorne, and John Archibald Wheeler (otherwise known as *MTW*). Steven Weinberg entered the fray in 1972 with *Gravitation and Cosmology*, a portent of things to come.

The present volume is a second edition of a 1990 (Oxford University Press) original, very much updated to include gravitational waves, the *Event Horizon Telescope*, and especially cosmology, including the use of Type Ia supernovae to demonstrate the acceleration of cosmic expansion. It is one of five recent texts increasingly weighing down my desk, as part of a quest for a text for an undergraduate major course on General Relativity and black holes for winter quarter 2024. All share a much larger fraction of pages devoted to cosmology, including inflation, details of the CMB, Big Bang nucleosynthesis, and structure formation than is present in the earlier volumes.

Kenyon devoted eight of his 17 chapters to these issues, *versus* four of 44 in *MTW*, one-seventh of one chapter out of nine in Joseph Weber’s 1961 *General Relativity and Gravitational Waves*, three of 24 chapters in James B. Hartle’s 2003 *Gravity: An Introduction to Einstein’s General Relativity*, and, for that matter, three brief sections out of 32 (called ‘Considerations on the Universe as a Whole’) in Einstein’s 1920 monograph. The explosion of cosmology has made most of these volumes too long for a 10-week quarter, or even a 15-week semester, despite sometimes leaving out the classic tests of gravitational redshift, light bending by the Sun, and advance of the perihelion of Mercury (all considered by Einstein). These have the advantage of being reasonably easy to understand. Kenyon includes Mercury and light bending in a chapter with the Shapiro time delay, geodetic precession and frame dragging, and gravitational lensing.

He attempts some history, crediting John Michell in 1787 with the first suggestion that large  $GM/R$  can mean an escape speed larger than the speed of light. A similar conclusion by Pierre-Simon de Laplace in 1795 does not appear. The binary pulsar 1913+16 appears as a graph of period change from the time of its discovery up to approximately 2013. The data are perfectly fit by a general-relativistic prediction of energy lost in gravitational radiation. Each chapter has half a dozen or so exercises, including distortion of a human too close to a black hole and calculation of the flux of gravitational-wave energy from the binary pulsar to be expected here in Irvine

That flux would be very similar in Birmingham, where the author was a member of the particle-physics group for more than 50 years. The present head of that group, Paul Newman, is thanked in the author's acknowledgements, but is, in turn, the writer of a short tribute to author Kenyon, who sadly died while the book was in the final stages of production. Kenyon was also the author of undergraduate textbooks on particle physics, classical and quantum optics, and quantum physics under the title of *Quantum 20/20*. Kenyon's view of dark energy is that it is a scalar field that behaves, in most respects, like Einstein's cosmological constant. He sounded less sure about inflation being the manifestation of another scalar field.

Oh. Am I supposed to tell you which tome I have adopted for Physics 116 here at UC Irvine? Naturally, the one that Kip Thorne told me is the best General Relativity text ever written. No, not *MTW*. Hartle's *Gravity*. —VIRGINIA TRIMBLE.

**To the Stars: Women Spacefarer's Legacy**, by Umberto Cavallaro (Springer) 2023. Pp. 594, 23.5 × 14.5 cm. Price £34.99 (paperback; ISBN 978 3 031 19859 5).

Here are 75 women cosmonauts, astronauts, taikonauts, and possibly other designations for those who have flown well above the Earth's atmosphere between 1963 and 2022. At least a few are, or have been, national heroines — Valentina Vladimirovna Tereshkova (born 1937) in Russia and the Soviet Union; Sally Kristen Ride (1951–2013) in the United States; and (I hope) Helen Patricia 'Lenochka' Sharman (born in Sheffield in 1963) in Britain, though she flew on a Soyuz mission (TM-12). The volume is chock full of firsts, some by nation (Liu Yang the first female taikonaut, Chiaki Mokui of Japan, Yi So-Yeon of Korea, on to Anousheh Ansari, the first Iranian spacewoman, again on a Soyuz (TNA-0)).

Others are first mother in space, first teacher, first actress, first EVA (Extra-Vehicular Activity) by a woman, the first astronaut's daughter in space (Laura Shepherd Churchley), not to mention other extremes like Wally Funk at age 82 on *Blue Origin NS-16*, the oldest person to fly, 60 years after she had been the youngest of the *Mercury 13* women who were briefly tested and trained by NASA but never flew.

The author gives his affiliation as the Italian Astrophilately Society in Torino and here demonstrates his passion for stamps showing astronauts by illustrating his short biographies with images of 'first day cancellations' of most of the women featured. Sally Ride, who appears on stamps of 13 different countries, was herself a collector, whose personal stamp collection was donated by her surviving partner, Tam O'Shaughnessy, to the National Postal Museum in Washington, DC.

Every one of the capsule stories has a 'gee whiz' item. One woman played her flute on the *International Space Station*; another later headed NASA's Astronaut Office. Elena Kardakova was born the year of the *Sputnik* launch. The youngest American astronaut to date (Hayley Arceneaux) is a cancer survivor who flew with a prosthetic limb. Kathryn Thornton (and Story Musgrave) were the first civilians assigned to a military Shuttle flight (they launched an ELINT). MD Bonnie Bondar has received 24 honorary doctorates from Canadian and American universities. Ellen Ochoa, born in Los Angeles the year NASA was established, is living proof that it is better to be a professional electrical engineer and an amateur classical flautist than the other way around, and has served as Director (the 11th) of the Johnson Space Flight Center in Houston, Texas.